Superconductivity in Doped Diamond

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Superconductivity has been found in boron-doped diamond by researchers in two laboratories. This dramatic result challenges models for superconductivity. We will demonstrate, however, that the phenomenon is a simple manifestation of superconductivity induced by proximity to a metal/insulator transition. We will show how the results obtained for doped diamond are quite analogous to behavior seen in several disparate classes of superconductors (disordered metals, oxide conductors-including high temperature superconductors, semiconducting materials, organic conductors and various forms of C60), whose only common feature is proximity to a metal/insulator transition (MIT), share a common phase diagram Tc(r). Here r is a coordinate characterizing the disorder and is completely defined in terms of measurable quantities. This remarkable phase diagram may be plausibly explained by explicitly incorporating an enhancement of the electron screening length, which occurs near the MIT, into the BCS equation for Tc.

Just recently we have studied Hc2 as a function of proximity to the MIT for many systems and find a similar common phase diagram for Hc2(r). Again, we find that the shape of the phase diagram for diamond is remarkably similar to that of several other systems.